LIBRARY OF CONGRESS
FEB 2 1914
SMITHSONIAN DEPOSIT

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1839–40. No. 16.

Monday, 2d December 1839.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Donations were presented :—

Outlines of Human Physiology. By William Pulteney Alison, M. D., F. R. S. E.—*By the Author.*

Two Essays. I. On the Nature of the Boetian Numerical Contractions. II. Notes on Early Calendars. By James Orchard Halliwell, Esq. of Jesus College, Cambridge.—*By the Author.*

Remarks on the Classification of the different branches of Human Knowledge. By J. W. Lubbock, Esq., F. R. S.—*By the Author.*

An Elementary Treatise on the Tides. By J. W. Lubbock, Esq., F. R. S.—*By the Author.*

Philosophical Transactions of the Royal Society of London for the year 1838. Part 2.—*By the Royal Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie Royale des Sciences, 1839. 1er Semestre. Nos. 13–25. 2d Semestre. Nos. 1–19.—*By the Academy.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van Der Hoeven, en W. H. De Vriese, M.D. Deel vi. St. 1, 2, 3.—*By the Editors.*

Proceedings of the Geological Society of London. Vol. iii. Nos. 60, 61, 62.—*By the Society.*

Transactions of the Institution of Civil Engineers. Vol. iii. Part 1.—*By the Institution.*

Proceedings of the American Philosophical Society. Nos. 5, 6, 7. —*By the Society.*

Bulletin de la Société de Géologique de France. Tome ix, Feuilles 28–32. Tome x. Feuilles 5–15.—*By the Society.*

Journal of the Asiatic Society of Bengal for September, October, November, December 1838.—*By the Society.*

The Quarterly Journal of Agriculture, and the Prize-Essays and Transactions of the Highland and Agricultural Society of Scotland, for June, September, and December 1839.—*By the Society.*

Nova Acta Physico-Medica Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vol. xviii. Part 2.—*By the Academy.*

Eloge Historique d'Antoine-Laurent de Jussieu. Par M. Flourens. —*By the Author.*

Archives du Museum d'Histoire Naturelle, publiées par les Professeurs-Administrateurs de cet Etablissement. Tome 1. Livⁿ 1.—*By the Editors.*

Recherches sur les Ossemens Fossiles de la Russie. Par G. Fischer de Waldheim.—*By the Author.*

Memoir of William Vaughan, Esq.—*By the Author.*

Transactions of the American Philosophical Society, held at Philadelphia, for promoting Useful Knowledge, Vol. vi. Part 2. (New series).—*By the Society.*

Memoires de la Société Géologique de France. Tome iii. Part 2. —*By the Society.*

Transactions of the Royal Society of Literature of the United Kingdom. Vol. i. Part 1. and Vol. iii. Parts 1, 2.—*By the Society.*

On the Enlisting, Discharging, and Pensioning of Soldiers, with the official documents on these branches of Military Duty. By Henry Marshall, F. R. S. E., Deputy-Inspector-General of Army Hospitals.—*By the Author.*

The Transactions of the Linnean Society of London. Vol. xvii. Part 2.—*By the Society.*

Proceedings of the Linnean Society of London. Nos. 1, 2—*By the Society.*

Quarterly Journal of the Statistical Society of London. July and Oct.—*By the Society.*

Memoires sur le Canada, depuis 1749 jusqu'a 1760.—*By the Lit. and Hist. Soc. of Quebec.*

An Essay on the State of Literature and Learning under the Anglo-Saxons. By Thomas Wright, Esq.—*By the Royal Society of Literature.*

Madras Journal of Literature and Science. 1838, April to December. 1839, Jan. to March.—*By the Madras Lit. Society.*

Transactions of the Royal Irish Academy. Vol. xviii. Part 2.—*By the Academy.*

Memoir of the late Honourable Nathaniel Bowditch, LL.D., of Boston. By N. J. Bowditch.—*By the Author.*

The Narrative of Capt. David Woodward and Four Seamen, who lost their ship while in a boat at sea, and surrendered themselves up to the Malays in the Island of Celebes.—*By Wm. Vaughan, Esq.*

Recueil de Voyages et de Mémoires, publié par la Société de Geographie. Tome iv.—*By the Society.*

Annuaire des Marées de Côtes de France pour l'an 1839. Par A. M. R. Chazallon.—*By the Author.*

Mémoire sur les divers moyens de se procurer une Base pour la mesure directe, par la vitesse du Son, par des Observations Astronomiques, &c. Par A. M. R. Chazallon.—*By the Author.*

Instructions pour Naviguer sur la Côte Orientale de Terre Neuve, depuis le Cap de Bonavista jusqu'au cap Normand. Par M. Ch. Lavand.—*By the Author.*

De l'Etablissement des Français dans la Régence d'Alger, et des Moyens d'en assurer la prospérité. Par M. P. Genty de Bussey. 2 tomes.—*By the Author.*

Rara Mathematica; or a Collection of Treatises on the Mathematics and subjects connected with them, from ancient unedited manuscripts. Edited by James Orchard Halliwell, Esq., F. R. S. &c.—*By the Editor.*

Mécanique Céleste. By the Marquis De La Place. Translated, with a Commentary, by Nathaniel Bowditch, LL. D., and with a Memoir of the Translator, by his Son. Vol. iv.—*By the Representatives of the Translator.*

Astronomische Nachrichten, Nos. 365 to 379.—*By Professor Schumacher.*

Astronomische Beobachtungen auf der Königlichen Universitats-Sternwarte in Konigsberg. Von F. W. Bessel. 9th Part.—*By the Author.*

Neue Wirbelthiere zu der Fauna von Abyssinien gehorig, entdecht und beschrieben von Dr Eduard Rüppell. Nos. 10, 11, 12 —*By the Author.*

Report upon the Military and Hydrographical Chart of the Extremity of Cape Cod, including the Townships of Province Town and Truro, with their Sea-coasts and Ship Harbour, projected from surveys executed under the direction of James D. Graham.—*By Professor A. D. Bache.*

Manuel Complet du Micrographie. Par Charles Chevalier.—*By the Author.*

The Journal of the Royal Geographical Society of London. Vol. ix. Part 2.—*By the Society.*

Address at the Anniversary Meeting of the Royal Geographical Society, 27th May 1839. By William R. Hamilton, Esq., F. R. S., President.—*By the Society.*

Narrative of the Discoveries of Sir Charles Bell in the Nervous System. By Alex. Shaw, assistant-surgeon to the Middlesex Hospital.—*By the Author.*

Report of the Eighth Meeting of the British Association for the advancement of Science, held at Newcastle in August 1838. Vol. vii.—*By the British Association.*

Memoir on the Mid-Lothian and East-Lothian Coal-Fields. By David Milne, Esq., F. R. S. E. and F. G. S.—*By the Author.*

Natuur-en Scheikundig Archief, uitgegeven door G. J. Mulder en W. Wenckebach. 1838. St. 3.—*By the Editors.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. Aus dem Jahre 1837.--*By the Academy.*

Bericht uber die zur Bekanntmachung geeigneten Verhandlungen der Konigl. Preuss. Akademie der Wissenschaften zu Berlin. Monats Juli 1838 bis Juni 1839.—*By the Academy.*

Remarkable case of Extrophy of the Urinary Bladder, with remarks. By P. D. Handyside, M. D.

History of the Sternoptixinæ, a family of the Osseous Fishes, and their anatomical peculiarities, with a description of the Sternoptix Celibes, a species not hitherto noticed. By P. D. Handyside, M. D.—*By the Author.*

Elements of Chemistry including the applications of the Science to the Arts. By Thomas Graham, F. R. S. L. and E. Part 1, 2, 3.—*By the Author.*

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 10.—*By the Society.*

Nineteenth Report of the Council of the Leeds Philosophical and Literary Society at the close of the Session 1838-39.—*By the Society.*

Annuaire Magnetique et Meteorologique du Corps des Ingenieurs des Mines de Russie. Par A. T. Kupfer.—*Par le Ministre des Finances.*

The American Almanac and Repository of Useful Knowledge for the year 1840.—*By the Amer. Phil. Society.*

Voyage dans la Russie Meridionale, sous la direction de M. A. Demidoff. Livraisons 1-23. Atlas au meme, folio.—*By Count Demidoff.*

Pilote Français Quatrieme partie comprenant les Côtes Septentrionales de France depuis l'Ile Brebat jusqu'a Barfleurs.—*Par la Ministre de la Marine.*

Maps of the Ordnance Survey of England and Wales. Nos. 71, and 74.—*By the Board of Ordnance.*

Maps of the Ordnance Survey of Ireland (County Kildare), 45 sheets.—*By the Board of Ordnance.*

The following communications were read :—

1. Solution of a Functional Equation, with its application to the Parallelogram of Forces and to Curves of Equilibration. By Dr Wallace, Emeritus Professor of Mathematics.

The functional equation to be resolved is this—

$$f(x_0)f(x_{,})=c\{f(x_0+x_{,})+f(x_0-x_{,})\}$$

In this equation x_0 and $x_{,}$ denote any two values of the indefinite variable x, and c is a constant quantity. The object of inquiry is the *forms of the function.*

It is proved that there are two forms of the function, which alike satisfy the proposed equation: viz.

$$f(x)=a\cos\frac{x}{c} \quad . \ . \ . \ . \ . \ . \ . \ . \quad (1)$$

$$f(x)=\frac{a}{2}\left\{e^{\frac{x}{c}}+e^{-\frac{x}{c}}\right\} \quad . \ . \ . \ . \quad (2)$$

In the first of these functions x increases, while $f(x)$ decreases; and in the second, x and $f(x)$ increase together. The first of these functions is applied in the paper to the theorem of the *Parallelogram of Forces,* whilst the theory of *Curves of Equilibration* is deduced from the second function: these last, in their most general form, have two parameters. The curve of equilibration is formed by a perfectly flexible chain suspended in a vertical plane between two fixed points. Suppose the chain loaded with heavy rods of equal thickness, which hang vertically from it, indefinitely near to each other, at equal horizontal intervals, and with their lower ends in a horizontal straight line. It is shewn that the equation to the curve is derivable from the functional equation already mentioned, and that its solution in that case gives (putting y to denote the ordinates $f(x)$)

$$y=\frac{a}{2}\left\{e^{\frac{x}{c}}+e^{-\frac{x}{c}}\right\}.$$

Amongst other curious results, the author establishes a relation between the arcs of these curves similar to the properties of the sines and cosines of the circle. It also appears that curves of equilibration may be constructed from the catenary, just as the ellipse is formed from the circle. A series of Tables accompany the paper, intended to facilitate the calculations of engineers for suspension bridges or equilibrated arches.

2. On General Differentiation. Part I. By Professor Kelland.

"As early as the time of Leibnitz, it was suggested that a general form might be discovered for differential coefficients, somewhat in the same way as that which applies to expansions. Notwithstanding this suggestion, the difficulty of the subject appears to have deterred mathematicians from engaging in it, until a few years since M. Liouville published a series of memoirs, in which its principles are developed, and theorems deduced applicable to the solution of a variety of difficult and important problems. Amongst a mass of particular results, the generalization of each of which would probably give a distinct aspect to the science, M. Liouville appears to have selected that one which is the most readily applicable to practice, and which, at the same time, affords conclusions remarkably convincing of its completeness. As far, then, as relates to the foundation of the theory, nothing is wanting: when we examine the formulæ themselves, we find much room for improvement. In the first place, not only are there different formulæ for every combination of differentials of simple quantities, but even the very modes of demonstration made use of to produce them, vary widely from each other. Certain of the conclusions themselves also appear to be inaccurate. Added to this is the circumstance, that M. Liouville has not effected the exhibition of any formulæ analogous to the ordinary formulæ of the Differential Calculus, such as Taylor's Theorem.

"The objects of the present memoirs are, 1. The completion of the science as regards its elementary theorems, by the exhibition of one general form, and the deduction of all other forms from it: 2. The application of the general theorem to a variety of cases analogous to those dealt with in the common differential analysis: and, 3. The demonstration and application of theorems of expansion, not subject to failure for particular values of the variable. To complete the subject, a vast deal more is required; but the author hopes, by the present essay, and another which he intends shortly to present to the Society, that the study of this important calculus will be excited; and confidently anticipates the consequent improvement and extension of its processes."

Monday 16*th December* 1839.

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following donations were presented:—

Journal of the Asiatic Society of Bengal, No. 85, for January 1839. —*By the Society.*

Transactions of the Meteorological Society, vol. i.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences (1839, 2nd Semestre). Nos. 20, 21, 22.—*By the Society.*

The following communications were read:—

Date?

1. Experiments on the Development and Growth of the Salmon, from the exclusion of the ovum to the age of two years. By Mr Shaw, Drumlanrig. Communicated by James Wilson, Esq.

T. 285

The author, in this paper, gives an account of the continuance and confirmation of his experimental observations on the growth of salmon fry, as formerly communicated to the Society. He considers the objections made to his artificial ponds, in so far as they were supposed to afford an insufficient supply of food, to be without reasonable foundation, as these ponds actually abound with the ordinary insect food of fishes, and the young broods themselves correspond in every way to those of the same age in the natural streams and pools of the river. He had previously ascertained and stated, that young salmon remain in their native river for two years (under the names of parrs, pinks, fingerlings, &c.), and during that period, or till near its close, he applies to them the name of *parr*, as that by which they are usually designated in Scotland.

The hatching of the ova is regulated in a great measure by the temperature of the season. In severe winters, the principle of life is slowly developed. He found, by experiment, that spawn placed in a stream of spring water of the average temperature of 40°, exhibited the embryo fish (visible to the naked eye) by the end of the 60th day, and was hatched on the 108th day after impregnation. Spawn deposited by the same parent on the same day *in the river* (the average temperature of which, for eight weeks, did not exceed 33°), did not exhibit visible young until the 90th day, and 131 days elapsed before their final hatching. Yet the departure of the more advanced fry *sea-wards* does not seem to depend on the variable time of hatching,—the first week of May, of the second ensuing season, being a very regular period for the main body, and on the occasion in question, large shoals of salmon fry were descending the river on the very day (10th May) on which the young of that year were only emerging from the ova. Yet the usual belief is, that they migrate in the course of the same spring in which they are hatched.

Mr Shaw's paper is accompanied by an extensive and varied collection of specimens, which exhibit the development of the fry from the period of hatching until the termination of the second year. A parr or young salmon twelve months old, measures about three and three-fourth inches in length, and exhibits what may be called the ordinary summer aspect. It corresponds in age and size with those which, in the natural bed of the river, are denominated "May parr," and it is these latter alone (with such as have been recently hatched) that are found in the river after the beginning of May, as about that period the two-year-olds all migrate to the sea. May parr are to be regarded as identical with the "Pinks of the river Hodder," alluded to by Mr Yarrell, but they are the produce of the preceding spring, instead of being, as usually supposed, only a few weeks old. They remain all summer, and throughout the ensuing winter, in the river, and, by an anomalous, or at least unusual, economy of nature, the males in the course of this early period become fit for generative purposes, and are seen to associate with the female adult salmon. A characteristic example of this stage was taken from the pond on the 14th November 1838, being then eighteen months old, and at that age all the males of the different broods exhibited a matured sexual character in relation to the *milt*, but none of the females of the same age shewed any signs of *roe*. Those in the bed of the river manifested the corresponding character of each sex,—that is, of maturity in the male, of immaturity in the female.

The great constitutional change which converts an old parr into a young salmon, usually takes place in the month of April of the second ensuing year. Specimens taken from the pond on the 5th of January 1839 measured six inches in length, and were twenty months old. They exhibited all the ordinary characters of the parr, commonly so called. But such as were allowed to survive till the 24th May, although they gained only half an inch in length, *cast off the livery of the parr*, and assumed that of the salmon,—this change consisting chiefly in the following particulars: the black opercular spots disappeared, the almost colourless pectoral fins became suffused with an inky hue at their extremities, the broad perpendicular bars or blotches on the sides were effaced, and the prevailing hues of dusky brown and yellowish-white were converted into deep bluish-black above, and into silvery white below. Various other specimens exhibited by Mr Shaw exemplify a similar change, and some of these distinctly shew, as it were, the intermediate or transitionary state between the parr and salmon. The whole, however, belonged to broods which, as formerly explained by the author, were the original produce of adult salmon.

The observations hitherto reported were made in confirmation and continuance of those formerly laid before the Society by the same author. But the circumstance of the male parrs in a state of sexual maturity being found to accompany the female adult salmon while she deposits her ova in the river, suggested the idea of the following singular and successful experiment. In the month of January 1837, Mr Shaw took a female salmon weighing 14 lb. from the natural spawning bed, from whence he also took a male parr weighing one ounce and a half. With the milt of the latter he impregnated the ova of the former, and placing the spawn in the stream of his pond he watched its development, as he had that of the salmon spawn fecundated in the ordinary way, and found the hatching and subsequent growth in all respects to correspond.

These experiments were repeated with the same results in the winter of 1838, and the parrs (taken from the river) which had been used as males, were kept alive till spring, when they assumed the migratory dress of young salmon. He also tried a corresponding experiment, by impregnating the ova of three adult female salmon taken from the river, with the milt of three parr bred in the confinement of the ponds, and the result was the same as to successful hatching and final growth,—this fact, moreover, shewing the constitutional strength of the pond-bred breed, and that they had not deteriorated or been altered in their natural character and attributes by confinement, as had been supposed. The specimens used in these experiments are exhibited to the Society, that all interested may satisfy themselves by ocular inspection.

One of these specimens is itself the produce of a male parr and female adult salmon; in other words, it is what naturalists (supposing the parr and salmon not to be identical) would call a hybrid or mule. Now, it is admitted by physiologists that the general rule in regard to these mixed productions, from kinds not specifically the same, is, that they do not breed; yet this male parr, originally produced from a parr and salmon, has itself become the parent of a numerous and healthy progeny of young salmon; and Mr Shaw attaches great importance to this fact, the experimental particulars of which are carefully detailed in his paper. It had, in truth, been objected to Mr Shaw's former experiments, that by a forced alliance between the parr and salmon, he had not proved their identity, but had merely succeeded in producing a *hybrid*. The brood, however, in no way differs from other young salmon in the parr stage, so far as external characters are concerned; and their procreative powers afford an additional confirmation of their being identical. Mr Shaw moreover observes, that, if the parr were a distinct species, the results of their attendance on the female salmon would produce universal confusion among the migratory inhabitants of rivers, "from the circumstance of the male parrs, in a breeding state, occupying in great numbers the very centre of the salmon spawning-bed; while the female salmon herself is, at the same instant, pouring thousands of her ova into the very spot where they are thus genially congregated."

Mr Shaw's experiments were conducted with great care; have been frequently verified by repetition; and have always been followed by the same results. He concludes his paper by stating, that so far as his own observations extend, the trough, or special spawning-bed, is excavated by the female alone, and by means of a peculiar action of the tail. The belief hitherto entertained has been, that she was greatly aided in this removal and replacing of the gravel by the snout and under jaw of the male. The process of laying usually occupies three or four days. He found in the course of his experiments, that the death of the female did not (at least within a short time) destroy the vitality of the spawn, or its receptive power of fecundation. He impregnated ova from the body of a fish which had been dead for nearly two hours, with the milt of a living parr, and vivification followed in the usual course.

2. On the use of the word "Temperature" in the Analytical Theory of Heat. By Professor Kelland.

"It appears to the author, that the only fact established by the experiments of MM. Dulong and Petit is the following:—That the scale of measurement by which we express our knowledge of the state of heat within a body, is not applicable to the expression of the flow of heat within or from the surface of the body. Proceeding upon this supposition, he deduces the thermometric temperature of a body, from the formulæ in v, given by M. Fourier, taking the formulæ as finally obtained, believing them to be accurate expressions of physical conditions. As, however, the letter v cannot, consistently with MM. Dulong and Petit's experiments, denote the thermometric temperature, but some exponential function of it, the author proposes, in order to prevent confusion, to employ the word "thermature" to denote that to which the flow of heat is proportional. Should his view of the matter be correct, investigations, similar to those given by M. Libri and others, in which the external radiation only is supposed to follow the exponential law of temperature, cease to represent physical facts. In order, therefore, to give an air of probability to the hypothesis, independently of that which it possesses arising out of the nature of the case, the author has tested it by the experiments of MM. Fourier and Biot, and finds that it applies equally well with the old hypothesis, which is confessedly a very close approximation to the truth for small differences of temperature. To complete the test, other experiments are wanted, such as those on the state of heat at one end of a short bar, corresponding to a given state of heat at the other. In this case, the old hypothesis totally fails; but from want of a sufficiently definite statement of the data in the experiment given by M. Biot, the author is unable to say whether or not his own views are confirmed by it. They certainly are not, as the old hypothesis is completely at fault when applied to it. The author hopes that, by the labours of some person interested in the subject, this, or some other *experimentum crucis,* will ere long enable us to decide this matter.

A third communication by Professor Forbes, "On the Influence of the Mechanical Texture of Screens on the immediate transmission of Radiated Heat," was placed in the hands of the Secretary, and the reading of it postponed till next meeting.

Monday, 6*th January* 1840.

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following Donations were presented :—

The Sixth Annual Report of the Royal Cornwall Polytechnic Society, 1838.—*By the Society.*

Abstract of the Returns of the Overseers of the Poor in Massachusetts for 1837 and 1838, prepared by the Secretary of the Commonwealth.

Abstract of the Returns of Insurance Companies, incorporated with Specific Capital in 1838.

Abstract exhibiting the condition of the Banks in Massachusetts, in February and October 1838.

Abstracts of the Massachusetts School Returns for 1837.

First and Second Annual Reports of the Board of Education.

Report of the Secretary of the Board of Education on the subject of School-Houses.

Report of the Committee on Education relative to the School-Fund.

Report and Resolves in relation to the North-Eastern Boundary in March 1838.

Report of the Bank Commissioners.

Schedule exhibiting the condition of the Banks in Massachusetts for every year from 1803 to 1837.

Report of the Commissioners on Codification of the Common Law.

Preliminary Report of the Commissioners on Criminal Law.

Annual Reports of the Railroad Corporations in the State of Massachusetts for 1838.

First Report on the Geology of the Public Lands in the State of Maine.

Report on a Re-examination of the Economical Geology of Massachusetts.

Statistical Tables exhibiting the condition and products of certain Branches of Industry in Massachusetts, for the year 1837.

Second Report of the Agriculture of Massachusetts.

Reports of the Commissioners of the Zoológical Survey of the State of Massachusetts.

Reports on the Fishes, Reptiles, and Birds, of Massachusetts.—*By the Family of the late Dr Bowditch.*

Second Part of the twentieth volume of the Asiatic Researches.

Journal of the Asiatic Society of Bengal, for February and March 1839.—*By the Society.*

Transits as observed, and calculation of the Apparent Right Ascension at the Cape of Good Hope, 1834.

Zenith Distances observed with the Mural Circle, at the Royal Observatory, Cape of Good Hope, and the calculation of the Geocentric South Polar Distances, 1836 and 1837.

Bessel's Refraction Tables.

Observations of Halley's Comet, made at the Royal Observatory, Cape of Good Hope, in the years 1835 and 1836.—By Thomas Maclear, Esq.

On the Declinations of the Principal Fixed Stars, deduced from Observations made at the Observatory, Cape of Good Hope, in 1832 and 1833. By Thomas Henderson, Esq.—*By the Lords Commissioners of the Admiralty.*

Prospectus and Illustrations of the Natural History of the Scottish Salmonidæ. By Sir William Jardine, Bart.—*By the Author.*

The following communications were read :—

1. On the Effect of the Mechanical Texture of Screens on the immediate Transmission of Radiant Heat. By Professor Forbes.

The following memorandum was communicated at the former Meeting of the Society.

" On the 2d September 1839, M. Arago communicated to the Academy of Sciences a letter by M. Melloni, containing some very interesting experiments on the transmission of Radiant Heat. M.

Melloni finds, that rock-salt (which is well known to transmit rays from every source with equal facility) acquires, by being *smoked*, the power of transmitting most easily heat of low temperature, or that kind of heat stopped in greatest proportion by glass, alum, and (according to M. Melloni) every other substance. The experiments contained in the Third Series of my Researches on Heat, shew that this is equivalent to saying, that substances in general allow only the more refrangible rays to pass; and as M. Melloni had been led by his previous experiments to the same conclusion, his statement amounts to this, that, whilst rock-salt presents the analogy of white glass, by transmitting all rays in equal proportions, every substance hitherto examined acts on the calorific rays as violet or blue glass does on light, absorbing the rays of least refrangibility, and transmitting only the others.

" M. Melloni believes, that the first exception to this rule, or the first analogue of red glass, is rock-salt previously smoked. I desire, however, first to call attention to the fact, that, in a paper published in May 1838 (Researches on Heat, Third Series), I described a substance having similar properties, namely, mica split by heat to extreme thinness, such as I employ in polarizing heat. In the month of March 1838, I had established, by reiterated experiments, that the transmission of heat through glass, far from rendering it less easily absorbed by mica in this peculiar state, had a contrary effect, and also that heat of low temperature, wholly unaccompanied by light, was transmitted almost as freely as that from a lamp previously passed through glass.

" It even appears, from experiments I have since made with the same form of mica, that some specimens transmit *scarcely half* as much luminous heat from a lamp previously passed through glass, as that from a body below visible incandescence.

" Mica itself, not laminated by the action of fire, possesses, as I have shewn by contrasted tables in the paper referred to (Art. 23, 24), properties exactly the reverse; hence the effect is due to the peculiar mechanical condition of the body, and not to its elementary composition.

" It, therefore, at once occurred to me, on reading M. Melloni's communication, that the effect of smoking the salt might be merely owing to a mechanical change in the surface affecting the transmission.

" Roughening the surface was the most obvious experiment, and I found, as I anticipated, that heat of low temperature is very much easier transmitted by salt scratched by sand-paper in two directions at right angles, than luminous heat. Thus, a plate of salt which, when well polished, transmits 92 per cent. of heat derived from a lamp, and sifted by a glass plate, and also 92 per cent. of heat wholly unaccompanied by light, transmitted, when roughened, only 17 per cent. of the former and 45 per cent. of the latter.

“ A thin plate of mica, when similarly scratched with emery-paper, so as merely to depolish it, transmitted much more nearly the same per-centage of heat from different sources than when *bright;* shewing, that the loss of polish affects the transmission of the more refrangible rays much more sensibly than that of the others.

“ Yet this effect is not attributable to a variation in the ratio of the reflection of heat of different kinds at the surfaces of the plate. For, in the *first* place, I have proved, and already communicated the fact to the Royal Society (see Proceedings for April 1839), that reflection takes place at a polished surface, with almost, if not exactly, the same intensity for all kinds of heat; and, *secondly*, I have found, by direct experiment, that, at least for the higher angles of incidence, reflection is most copious from rough surfaces for heat of low temperature, or the same kind which is most freely transmitted, proving incontestibly that the *stifling* action of rough surfaces is the true cause of the inequality.

“ That there is a real modification of the heat in passing through a roughened surface, as well as through laminated mica and the smoky film, appears from direct experiments which I have made on the heat sifted by these different media; which, when transmitted by any one of these, is found in a fitter state to pass through each of the others; and this modification is found to be more perceptible, as the character of the heat is more removed from that which these media transmit most readily, that is, as the temperature of the source is higher. Thus, heat derived from a lamp, has 36 per cent. transmitted by a certain smoked plate of rock-salt. But if the heat transmitted by the smoked salt has previously been sifted or analyzed by transmission through another plate of smoked salt, through laminated mica, and through roughened salt, the percentage is raised from 36 to 44 in the two former cases, and to 40½ in the latter, proving incontestibly the specific action of these transmissions in arresting the more refrangible rays.

“ I next considered, that, as a moderate number of scratches appeared to produce this modification, it might be practicable to obtain the effect by transmitting heat simply through fine wire-gauze.

I could not obtain it finer than sixty wires to the inch, and in this case I could obtain no indications of differences in the transmitted ratios of one or other kind of heat. The proportion transmitted to the direct effect, was, in every case, almost exactly that of the area of the interstices of the gauze to its entire surface.

" When fine gratings (used for Fraunhofer's interference fringes) made of cotton-thread were used, even in this case no difference was perceived; here, however, the thread having probably a certain degree of permeability, might mask the effect.

" When fine powders were strewed between salt plates, leaving minute interstices, the easier transmission of heat of low temperature was again apparent.

" Having procured delicate lines to be drawn with a diamond point on a polished salt surface, first dividing it into squares 1–100th inch in the side, then into parallel stripes 1–200th inch apart, and finally into squares of the latter dimension, in every case the effect resembled that of random scratches, and was made apparent as the surface was more furrowed.

" I have finally to observe, that the mere process of natural tarnishing by the exposure of salt to the air, produces a similar effect.

" These facts evidently point to phenomena in heat, resembling diffraction and periodic colours in light. I cannot doubt that the simple transmission through fine metallic gratings, would produce effects similar to those of the striated surfaces of rock-salt."

" *December* 16. 1839."

2. On the Functions of the Roots of the Spinal Nerves in corroboration of former observations, proving that the anterior roots are nerves of motion, and the posterior nerves of sensation. By Sir Charles Bell, K.H.

The instance produced was a case which had occurred in the Infirmary, in which the anterior roots of the nerves arising from the *cauda equina* were engaged in a tumour, and the consequence during life, was the loss of muscular power, sensibility remaining unaffected.

The following candidates were elected Fellows of the Society:—

Alan Maconochie, Esq.
Martyn J. Roberts, Esq.
Dr Daun.

Monday, 20*th January*.

Right Hon. Lord GREENOCK, V. P. in the Chair.

The following communications were read:—

1. On General Differentiation. Part II. By Professor Kelland.

" In the preceding memoir on this subject, the author had confined himself to the fundamental operations leading to the differential co-efficients of various functions. In the present paper, he offers an illustration of the entrance of such coefficients into the analysis of physical and geometrical problems. Having first established a general theorm, connecting finite integrals of a certain form with fractional and negative differentials, the author adapts it to represent the integrals actually occurring in several problems. By this means he wishes to shew that the theory of General Differential Coefficients will at some future period become a powerful instrument in the hands of analysts, by furnishing them with results comprehended under general forms, and thus opening another section of the science of comprehensive memory."

Out

2. On the Means employed to prevent Forgeries of Bank Notes, Bills of Exchange, Cheques, &c. By Dr Traill.

" The author prefaced his remarks by a short history of Bills of Exchange, and other kinds of paper currency; in which he pointed out the economy and convenience of a well regulated *paper circulation*.

to 293

" The means usually employed to diminish the facilities to forgery are—

" 1. Colouring the paper, or the pulp of which it is manufactured, by various vegetable and mineral substances, either singly or combined. The best attempts of this sort have been imitated by a clever hand and a pencil.

" 2. Certain *water-marks* in the paper of the note or bill, as that employed by the Bank of England. A good imitation of this would perhaps require the connivance of a paper-maker; but successful imitations of *water-marks* have been made by gum and a pencil, or by pale tints of China ink to imitate a worn note.

" 3. Printing notes in different colours, from two or more wooden blocks, increases the difficulty of forging; instances of this were given in the coarse Excise paper stamp, and in the more elegant L.1 note formerly issued by the Bank of Ireland.

"4. The excellence of the engraving—a well executed imitation would require the aid of an able artist; and as engraving on copper and on wood produce these effects by *opposite* means, if designs from both were used on each note, the difficulty of engaging *two* eminent artists in such a nefarious trade would enhance the obstacles to successful forgery. The tracing on copper by an engine any series of curves, may easily be imitated by what is called engine-turning; but the most perfect specimen of this sort of engraving is that devised by Mr Perkins.

"5. Numbering each note has been adopted by all banks, and some number them both with impressions from copper and from wood. These have all been successfully imitated; yet this numbering often has led to the detection of forgery. The numbering-engine, used by the Bank of Ireland, is the most perfect which the author has seen, combining speed with accuracy, and registering its own work with unerring precision.

"6. The signatures of some of the officers of the bank have usually been added to the note, from the known difficulty of exactly imitating a handwriting.

"7. Frauds on bills and cheques have been committed by deletion of the common ink in which the amount of the bill has been written—the substitution of a larger sum. The author recommends the use of an ink, not effaced by chemical agents, without damaging the paper. For this purpose, he conceives that a carbonaceous ink, submitted by him to this Society some time ago, is well suited; especially when used on the softer kinds of paper, such as that made by the engine now used for making paper in one continuous sheet."

Monday, 3d February.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following paper was read:—

1. Observations on the Influence of various circumstances in Vegetation in modifying the Physiological Actions of Plants. By Dr Christison.

"The author commenced with some remarks on the various causes by which the actions of plants and of their products on the animal body may be modified, and on the great vagueness and uncertainty of the information at present possessed in regard to the influence of those causes which seem to arise in peculiar circumstances of vegetation, more especially climate, weather, soil, and the progress of vegetation. He then stated the sources of information on these points, namely, the curative or therapeutic action of drugs on man,—their effects on the healthy functions both of man and animals, either as medicines or as poisons,—their sensible qualities, —and their chemical analysis; and he assigned reasons for discarding the first of these from the inquiry, and for trusting, in a great measure, to the criterions derived from sensible qualities,—from the effects of poisons on the lower animals,—and from chemical analysis.

" The remaining part of the present paper was confined chiefly to the influence of the Progress of Vegetation on the activity of plants. Doubts were thrown by the results of his investigations on most of the current doctrines on this head; but the present state of the inquiry did not lead to any general inferences being drawn with confidence.

" An extended statement was made upon the influence of the progress of vegetation upon many of the active species of the natural family *Ranunculaceæ*. It was stated, that, in the acrid species of the genera Ranunculus, Anemone, and Clematis, the acridity, which is the same throughout them all in quality, is possessed in nearly equal activity by the leaves, from an early period in the spring until they are about to decay; but that it exists in the germens only while they are green, and disappears there entirely as the seeds ripen. In the acrid species of *Aconitum*, the acridity of the leaves, on the contrary, continues only until the seeds begin to form, and then gradually, but quickly, disappears as they ripen, while the seeds acquire precisely the same peculiar kind of acridity. The narcotic properties of the leaves, however, do not undergo the same singular change, but continue undiminished after the seeds are mostly ripe, and probably, indeed, as long as the leaves themselves retain their freshness. The acridity of the genus *Helleborus* is probably governed by circumstances different from any of those already mentioned; but the experiments already made are insufficient to point out the true rule.—In the course of these observations many remarks were also made on the nature of the acridity possessed by the different species, upon which incorrect ideas at present very generally prevail; several material corrections were also suggested as to the general opinions respecting the influence of heat, desiccation, and time, upon their acridity; and a short allusion was made to the properties of a remarkably crystalline principle which the author discovered in one of the species of Ranunculus, and which appeared to him to be the ingredient upon which the activity of that genus depends.

"The author next entered into some details regarding the influence of the progress of vegetation on narcotic plants, and commenced with the natural family *Amygdaleæ*, the leaves of several of which are eminently poisonous, in consequence of containing, or producing, when bruised, a hydrocyanated essential oil. He shewed that this oil abounds most in the leaves of the cherry-laurel (*Cerasus laurocerasus*), when they are young and undeveloped, and that it goes on diminishing gradually in proportion to their weight, as they increase in age and vigour, until the commencement of their second season, when the old leaves, though plump and luxuriant, do not contain above an eighth or tenth of what they contained in the infant state, or of what is contained in the young undeveloped leaves of the same period. This is a complete reversal of the generally-admitted law in respect of the formation of volatile oils in leaves.

"The consideration of this fact led to some statements upon the mode and form in which some essential oils, and other active principles, exist in the leaves of plants; and the conclusion was drawn, that in all probability many active principles, which are separated from plants by simple processes, do not exist ready formed in the leaves; but, as in the familiar case of the mustard-seed and bitter almond, are only developed when the structure of the leaves is broken up, and principles of a different kind, secreted in distinct cells, are brought in contact with one another, or with water.

"The remaining departments of the investigation were postponed; but further observations were promised, upon the influence of the progress of vegetation on the Solanaceous and Umbelliferous plants; and likewise on the effects of soil and climate."

2. A Specimen of *Clavagella Balanorum* (Scacchi), presented by Sir Thomas Brisbane, Bart., President of the Society, was laid on the table, with the following Remarks by Dr Traill.

"This is a rare and interesting species of *Clavagella*, now inhabiting the shores of Naples, presented by Sir Thomas Brisbane.

"When that part of Lamarck's work on *Invertebrata*, which contained the class *Conchiferæ*, appeared in 1818, among the order *Tubicolæ*, he introduced the genus *Clavagella*, of which he describes four species only, and they are all *fossil.* Even at the conclusion of his great work, in 1822, he appears not to have known any living species.

"Another species was described by Sowerby, from a specimen in the British Museum, and to these may, perhaps, be added a fossil species in my cabinet, which occurs in the vast shell limestone formation mentioned by Humboldt, as extending to some distance inland along the shores of the Mexican Gulf.

"The character of *Clavagella* is—An animal inhabiting a testaceous sheath or tube, open, but contracted anteriorly, and club-shaped posteriorly; sheath furnished with spinous tubes. Within the sheath is an equivalve bivalve shell, one valve of which is immoveably attached to the sheath, the other free, and united to the other by a cartilaginous hinge. Both cover the body. The animal is an inarticulate mollusque, without head or eyes; a concealed unarmed mouth; a large mantle, with two lamelliform lobes. External bronchial openings placed between the body and mantle on each side.

"It belongs to the division Crassipedes."

The following candidates were elected Fellows of the Society:—

R. Chambers, Esq.
James Forsyth, Esq.
Sir John Macneill, G. C. B.

Ac. 3034